PUBLIC HEALTH GEOGRAPHIC INFORMATION SYSTEMS (GIS) NEWS AND INFORMATION: 1994-1997

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Geographic Information Systems (GIS) at CDC/ATSDR: A new science for understanding disease

The use of (GIS) in disease surveillance, research and analysis has been a recent and welcome development in the field of public health. During the last several decades, GIS technology had been primarily the domain of those in the physical, earth, land management and urban planning sciences. It is now becoming an established tool at the Centers for Disease Control and Prevention (CDC) and Agency for Toxic Substances and Disease Registry (ATSDR), and in the public health sector.

During the 1990's, GIS at CDC and ATSDR emerged as an important technology for many public health applications including disease surveillance, risk assessment, environmental exposure, optimization of health resources allocation, exploratory spatial data analysis and spatial statistical modeling. The President's "National Spatial Data Infrastructure" (Executive Order 12906, April 11, 1994) as well as evolving computational advances in digital computer capabilities have given strong impetus to this new era of improved management, exchange and analysis of georeferenced databases.

GIS use in public health is also gaining momentum by its adoption at all levels of government. A growing number of the approximate 3,000 U.S. state and local health departments are in the process of incorporating GIS into their daily disease surveillance and prevention activities. In addition, GIS and public health have provided a common ground for scientific study by cognitive psychologists, geographers, statisticians, computer scientists, epidemiologists, physical scientists, hydrologists, ecologists, and others.

GIS science is built around the construction, storage, manipulation, uses and map display of computerized digital georeferenced databases. Database linkages are facilitated through common geographic identifiers such as latitude and longitude. For example, the ability to integrate health outcome data with existing environmental, earth science and social databases creates new opportunities for improved scientific analysis of associative causation in human and animal disease etiologies than in the past.

Those who work with GIS in public health face a variety of digital database and computational challenges. These include (1) how to georeference or geocode information, (2) how to manage effectively large georeferenced databases, (3) how to bring remotely sensed (aerial photography and earth satellite) information into a database, (3) how to use related Global Positioning Systems (GPS) technology in data collection, (4) how to use Bureau of the Census, US Environmental Protection Agency, US Geological Survey and other national, regional and local GIS databases for analysis, (5) understanding Boolean and relational operators for spatial and suitability analysis, (5) understanding and testing for spatial statistical relationships including spatial autocorrelation, kriging, regression and

modeling, (6) adopting data confidentiality techniques for masking small area geographic identifiers for analysis and data sharing, (7) using established metadata procedures (set forth by the US Office of Management and Budget's Federal Geographic Data Committee) for documenting georeferenced databases, and (8) how to make effective cognitive GIS mapping displays for presentation, analysis and Internet use.

GIS will empower a new era in epidemiologic exploration and discovery at CDC in many areas, particularly in survey analysis and disease surveillance. Major national surveys, including the National Health and Nutrition Examination Survey and National Health Interview Survey, are being retrospectively fitted with address geocodes and future surveys will contain them when fielded. Coupled with other environmental and social georeferenced databases, we will gain new analytic understanding of important small area variations and departures in the health of population subdomains and geographic areas that collectively constitute the national health profile. Through geocoding and an understanding of other earth science databases, we can build integrated sample designs that take into account suspected explanatory variables of disease association and occurrence never before tested. Geocoding in national health surveys will allow for new and more comprehensive scientific examination of the health of people and respective geographic locations.

In disease surveillance, GIS offers possibilities to detect and prevent disease outbreaks more effectively than ever before in public health history. For example, geocoded address information for decedents (from state certificates of death) and notifiable infectious disease occurrence (from local health departments), could lead to a highly responsive national disease surveillance system in which timely reports of cause of death are spatially monitored (address matched to city block or other small areas) and statistically tested for potential outbreak thresholds in both time and space. Used in concert with other GIS databases, the monitoring of national medical and health-related events will provide a new scientific basis for hypothesis generation and disease prevention strategies. These GIS possibilities provide CDC some challenging but achievable goals in the next 5-10 years.

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In response to the many new opportunities presented by the use of GIS in public health, a bimonthly report of the CDC/ATSDR GIS Users Group was initiated. Begun in October, 1994, the report was initially named "GIS News and Information." More than 300 CDC and ATSDR staff user group members received this first electronic mailing.

Since that time the number of GIS User Group subscribers has more than doubled and the report has undergone several changes. Perhaps the most beneficial change has been the expansion of the user group to include other professionals, with similar interests in GIS and public health, from outside of CDC and ATSDR. Nearly half of all participants today are from other federal institutions, state and local health departments, academic departments and industry. The strength of this group lies truly in the diversity (training and occupations) of the subscribers and their contributions to the report. The change in name of the report to "Public Health GIS News and Information," two years later, reflects the

inclusionary design of the users group.

The purpose of this working series paper is to chronicle the first three years of information exchange among the GIS users group. This should be of special value to physical, social, behavioral and other scientists now contemplating the use of GIS in public health. Starting on the next page, the reader will find all 18 editions that were assembled, edited and distributed from 1994-1997.